10/009690
JC13 Rec'd PCT/PTO 13 DEC 2001

3/prts

"Arrangement for equipment related to horizontal, continuous casting of metal"

~~Equipment for continuous casting of metal, in particular aluminium~~

The present invention concerns equipment for continuous, horizontal casting of metal, in particular aluminium, including an insulated reservoir or pool, which is designed to contain liquid metal, and a mould, which can be removed from the pool, with an insulating plate with holes which communicate with the mould. The mould includes a preferably circular mould cavity with a wall of permeable material, for example graphite, for the supply of oil and/or gas which wall provides primary cooling to the metal being cast, and at least one slit or nozzles arranged along the circumference of the cavity for the direct supply of coolant, providing secondary cooling to the metal.

As stated above, directly cooled horizontal casting equipment for continuous casting of metal in which oil and/or gas is supplied through the mould cavity wall through an annulus or a permeable wall element in order to form a lubricant film between the mould wall and the metal is already known.

Although this type of casting equipment functions reasonably well, the quality of the cast product is, however, much poorer than that of equivalent vertical casting equipment in which, in addition to oil, gas is also supplied through the cavity wall.

One of the disadvantages of vertical casting equipment is that it comprises a large number of moulds. This makes it expensive to produce.

Moreover, the vertical equipment is only designed to cast specific lengths in a semi-continuous process. This also makes it expensive to operate.

Casting with horizontal casting equipment involves the use of only a few moulds and the casting takes place continuously. Suitable lengths of the cast product are cut off during the casting operation. The continuous, horizontal casting equipment is thus both cheap to produce and cheap to operate.

One aim of the present invention was to produce horizontal equipment for continuous casting of metal, in particular aluminium, with which the quality of the cast product is as good as the quality of the equivalent cast product with vertical casting equipment. Further, an object with the present invention has been to provide equipment that is flexible with regard to casting different types of alloys.

The equipment in accordance with the present invention is characterised in that the primary cooling is designed to enable increased or reduced cooling of the metal being cast.

Dependent claims 2-5 define the advantageous features of the present invention.

The present invention will be described in the following in further detail using examples and with reference to the attached drawings, where:

Fig. 1 shows, in part, in an elevation, the casting equipment for continuous horizontal casting of long objects, for example aluminium tie rods.

Fig. 2 shows, in large scale, the mould shown in Fig. 1, a) in cross-section and b) in a longitudinal section.

As Fig. 1 shows, the casting equipment 1 in accordance with the present invention comprises an insulated metal reservoir or pool 2 and a mould 3. The pool 2 is provided with a lateral opening 4 to the mould 3, where a connecting ring 5 of thermally insulating material forms the transition between the pool and the mould 3. On its side, the mould is releasably attached to a holding device 6. Via a hinge link 7, it is possible to swing the holding device and thus the mould 3 from a position in which it is in contact with the connecting ring 5 to a swung-out position which makes it possible to remove (replace) or repair the mould.

The mould itself, which is shown in further detail in Fig. 2, comprises a two-part annular housing, of which a first main housing part 8 is provided with drilled holes 10,11 for the supply of oil or gas to interior, permeable cavity rings 12,13, while a second housing part 9 is provided with an annular recess which forms a water cooling channel 14. The two housing parts 8 and 9 are held together by means of a

number of screws 15. When they are screwed together, as shown in the figure, a diagonal slit or gap 16 is formed between the two parts so that, during the casting operation, water flows from the channel 14 and through the gap 16 along the entire periphery of the cast product just outside the outlet of the cavity 17. Hereby a primary cooling circle (primary cooling of the metal being cast) is formed by transport of heat through the wall (13,14) and to the water in the channel 14, and a secondary cooling circle by the water being ejected directly on the metal through the slit 16.

As mentioned, permeable rings 12, 13, which are physically separated from each other by a gasket, sealing material 18 or similar, are included. These rings form the wall in the cavity 17.

An important feature of the present invention is that the annuli 20 (see Fig. 2, b)) formed between the mould housing 8 and the rings 12,13 are provided with plugs 21 or similar (only 2 shown in the drawing) so that the annuli 20 are broken up into two or more restrictions sectors as required. In this way, the supply of both gas and oil can be differentiated along the circumference of the cavity. Such differentiation, in particular of the gas supply, is important in order to be able to achieve a good casting result.

Supply of gas to horizontal casting equipment is previously not known. To avoid inclusion of excess gas in the metal under the casting operation a bore 29 is preferably provided in the upper part of the mould cavity. The bore stretches through the ring 12 to an annulus outside the ring to another bore (now shown) leading to the atmosphere.

At the inlet of the cavity 17, there is a plate 19 of thermally insulating material ("hot-top") which is held in place using a retaining ring 22 via a screw connection 23.

As the wall of the cavity 17, i.e. the rings 12, 13, forms the primary cooling area during the casting operation, the area of the wall surface will represent one of the factors which determine the cooling of the metal.

The insulating plate 19 may, depending on the type of alloy and the primary cooling required, extend along the ring 12 (at 24) somewhat.

As the plate can be easily detached, it will be easy to replace the plate and thus cast different types of alloy in the same mould.

Otherwise, the casting equipment in accordance with the present invention works as follows:
Liquid metal, for example aluminium, is poured into the pool 2 from a casting furnace or similar (not shown). The metal flows through the opening 4 and the holes 25, 26 in the plate 19 into the cavity 17.

At the beginning of the casting operation, the outlet 27 in the mould 3 is closed using a mobile casting shoe (not shown). As soon as the metal has filled the cavity 17, the shoe begins to move, while water is supplied through the gap 16 and gas and oil are supplied through the ring 12, 13.

As the casting shoe moves and the cavity is refilled with metal via the pool, a long casting piece is formed. The shoe is removed as soon as the casting piece has reached a certain length. Since the casting process is continuous, the casting piece may actually be of any length. However, it is expedient for the casting piece to be cut (not shown) into suitable lengths for extrusion or other purposes.

As mentioned above, the casting equipment is designed for differentiated supply of oil and gas around the circumference.

In particular regarding the supply of gas, it has been found expedient to supply the same quantity of gas around the entire circumference of the cavity at the start of the casting process. Subsequently, when the casting process has started and has become stable, the gas supply to the upper area of the cavity is reduced or omitted.

Moreover, regarding the primary cooling, i.e. the cooling through the rings 12, 13 in the cavity 17, it has been found expedient, in order to reduce the cooling, to make the mould housing 8, of steel instead of aluminium, which is the usual material. Furthermore, in order to reduce the cooling further, it may be necessary to shield (reduce the thermal transfer to) the cooling channel 14 by arranging an insulating annular plate 28, for example of Plexiglas, on the side of the housing part which

faces the cooling channel. This may preferably be exchangeable and be of different thickness.

The invention as defined in the claims is not restricted to the embodiments shown in the drawings and described above. Thus, instead of two rings (12,13) forming the wall of the mould cavity, only one ring may be employed whereby the oil and gas may be supplied through this one and only ring.